

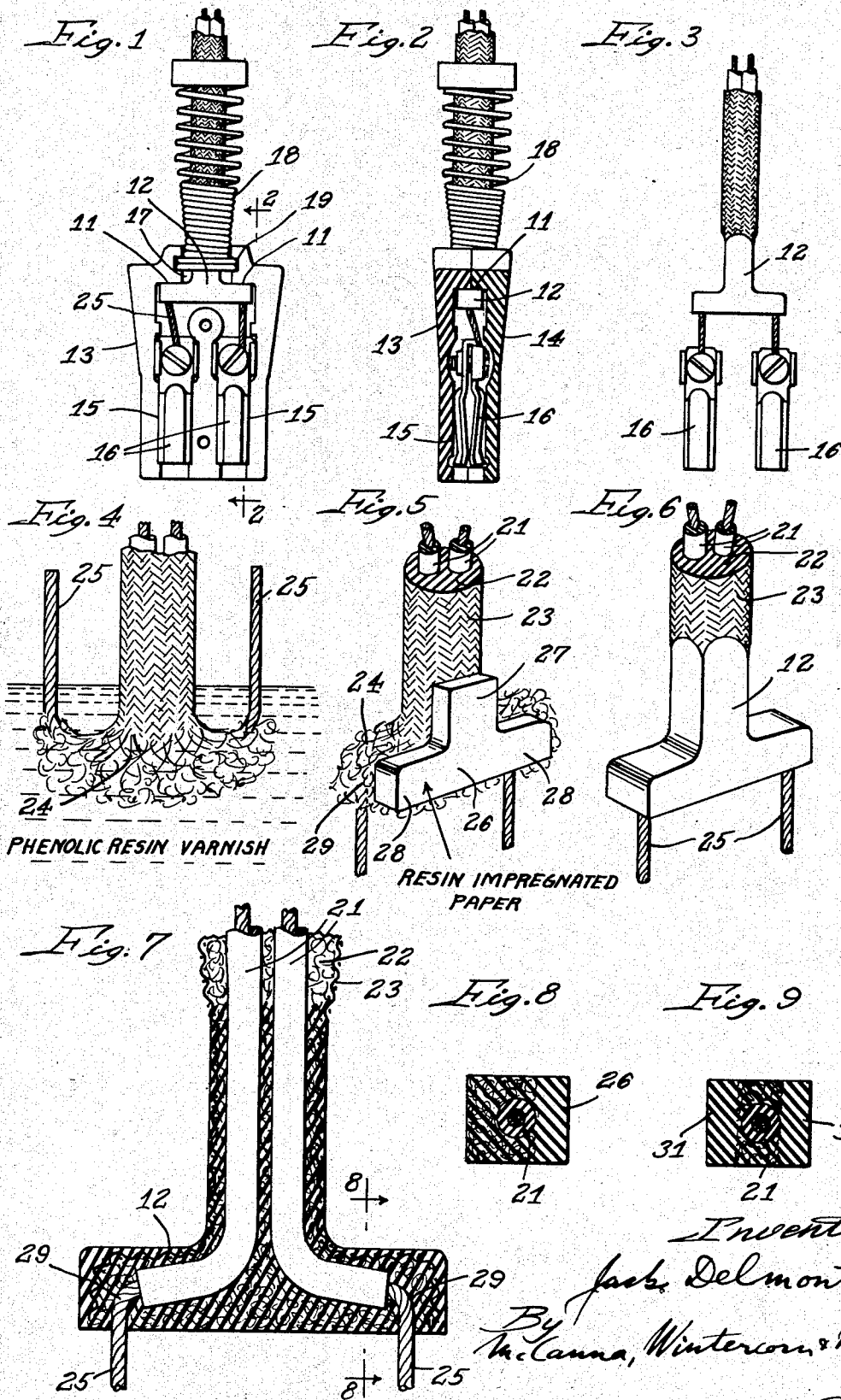
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METHOD OF MAKING STRAIN-RELIEF STRUCTURE

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METHOD OF MAKING STRAIN-RELIEF
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1 Claim. (Cl. 18—59)

This invention relates to the manufacture of articles having flexible portions adapted for connection to solid structures and wherein pulling tensions are imposed on the connection. More particularly, my invention relates to strain-relief structures or the like for electric cords used for attachment to electric appliances such as toasters, flatirons, waffle makers, coffee makers, etc. My invention also relates to the method of manufacturing a structure or article of this kind.

One of the sources of serious difficulty in appliance plugs is the connection between the cord terminals and the plug. Because of the nature of the devices with which the plugs are used and the fact that these devices are usually hot, the plug is commonly removed from the appliance by pulling on the cord. With a well made and efficient plug the terminal posts of the appliance are gripped tightly by the plug terminal clips and this, in addition to the growth of electrolytic corrosion products between the clips and posts accompanying high temperatures and prolonged operation, tend to make the removal of the plug difficult and place a severe strain on the terminal connections. As a result, the cord is apt to be pulled loose from the plug if adequate strain relief is not provided. This is recognized by manufacturers as well as by the National Board of Fire Underwriters, the latter of which require that the connection shall be equipped with a strain relief which will withstand for a period of one minute a straight pull of 50 pounds applied between the cord and the appliance plug, and further, that it should withstand for a period of one minute a torque of 3 inch-pounds applied between the cord and the plug. These conditions are difficult to meet without costly changes in plug construction and without making other changes in the shape and design of the plug, which in some instances will interfere with the operation thereof.

An important object of the invention is, therefore, to provide an improved strain-relief structure for electric cords which may be applied both to the detachable type of attachment plug and to cords which are intended to be permanently attached to an appliance.

More particularly, my invention has for one of its objects the provision of a strain-relief structure characterized by a homogeneous and permanent union of the fibrous sheath of the electric cord with the solid body which provides the strain-relief surface and which coats directly with the attachment plug or the appliance, according to whether the connection is of the de-

tachable or permanent type. This homogeneous union and the structure in which it is embodied gives new and improved results, as will be pointed out more fully hereinafter.

Another object of my invention is to provide a novel method of manufacturing strain-relief structures of the character described characterized by the steps of treating a portion of the fibrous sheath of the electric cord with a heat reactive moldable resin so as to thoroughly impregnate the structure and to provide a portion capable of being molded, and subjecting said treated portion to heat and pressure in a mold which is shaped to provide the configuration of the intended strain-relief body, in consequence of which the said treated portion is molded into a homogeneous structure of the desired shape. In the preferred embodiment as applied to a strain-relief for coaction with an attachment plug the steps are carried out substantially as follows: First, the fibres or strands of the fibrous or woven sheath are loosened and separated so as to provide an enlarged, spread-out portion. This portion is then treated with a heat reactive moldable resin such as phenol-formaldehyde resin or urea-formaldehyde resin, and then the portion so treated is subjected to heat and pressure in a mold as above described with the result that the resinous material becomes intimately associated with the fibres of the insulation and fills the small interstices between the fibres and strands with the result that a solid homogeneous structure is obtained which has strength, durability, low moisture absorption, and is unaffected by heat to which these connections are ordinarily subjected. The solid structure provides exceptionally durable thrust resisting surfaces, and the solid portion is so united with the flexible cord as not to impair the connection between the two but rather to provide a strong and durable connection.

Another object of my invention is to provide a novel method of manufacture whereby an article of the character described may be commercially produced at comparatively low cost.

Another object is to provide a novel method of manufacture distinguished from prior molding methods, in that an assembled fibrous structure capable of absorbing or retaining a moldable synthetic resin or cellulose derivative is treated in part with said resin and a particular section of the assembled fibrous structure is molded to a solid section while the remaining portion retains its flexible physical identity.

Other objects and attendant advantages will be appreciated by those skilled in this art as

the invention becomes better understood by reference to the following description when considered in connection with the accompanying drawing, in which

Fig. 1 is a side elevation of an appliance plug to which my invention has been applied, with the rear section of the plug body removed;

Fig. 2 is a longitudinal cross section taken substantially on the line 2—2 of Fig. 1;

Fig. 3 is a side elevation of the strain-relief structure removed from a plug but with the terminal posts attached;

Figs. 4 and 5 are somewhat diagrammatic views of the cord on an enlarged scale showing the different steps in the process of manufacture which will be described more fully hereinafter;

Fig. 6 is a perspective view on the corresponding scale showing a finished article in this embodiment of my invention;

Fig. 7 is a further enlarged view showing a longitudinal section through the finished article, Fig. 6;

Fig. 8 is a section taken on the section line 8—8 of Fig. 7; and

Fig. 9 is a corresponding section showing a modification in the manufacture.

In the drawing I have shown my invention as applied to a strain-relief structure for an appliance attachment plug. The plug itself may be of any suitable or preferred construction but adapted to have one or more strain-resisting shoulders 11 adapted for coaction with complementary surfaces of the strain-relief structure which is here designated generally by 12. In this instance the plug body is formed of two half-sections 13 and 14 shaped interiorly to provide grooves 15 for the reception of contact elements 16, and an opening 17 for reception of the terminal end of the electric cord and its strain-relief structure. The plug sections may be fastened together by suitable means well known in this art. In a plug of this type it is desired to protect the electric cord at its entrance into the plug body by means of a spring wire sheath 18, the inner end of which is retained in a groove 19 formed in the plug sections.

Referring now more particularly to the manufacture of the strain-relief structure as applied to attachment plug of the kind described, it will be observed that the first step is to strip or remove the fibrous cover or sheath from the end of the cord which is to be attached to the plug, leaving the two terminals of the conductor wires bare. In the type of electric cord shown in the drawing each conductor may be individually covered by a rubber insulation 21 and these insulated wires are encased in a sheath 22 of fibrous insulation material such as asbestos, and the latter is encased in a woven fabric sheath 23. The asbestos fibre 22 and the fabric sheath 23 are stripped back and loosened at the end of the cord sufficiently to provide an enlarged spread-out portion in which the fibres and strands are separated and make a considerable mass designated generally by 24. The ends 25 of the conductor wire are then turned back upon themselves substantially as shown in Fig. 4, preparatory to the treating step which follows. In this step the spread-out end of the cord is treated with a heat reactive moldable resin in such manner that the resinous material becomes intimately associated with the fibres and strands and fills the interstices thereof. Preferably, this end of the cord is emersed in a resin varnish

solution which is prepared from a heat reactive resin and a suitable solvent such as alcohol, or said end may be intimately treated with powdered resin. The term "heat reactive moldable resin" is used broadly herein to designate a thermosetting synthetic or natural resin or cellulose derivative which is capable of further flow as during molding. The cord is emersed for a short period and then immediately withdrawn, sufficient to permit the absorption of an adequate amount of resin from the solution. After a short drying period of approximately 10 minutes, the resin impregnated cord is placed within a mold (not shown) of the type commonly used for molding phenolic resin products and in this instance shaped to provide the configuration of the strain-relief body heretofore designated as 12. Following this there is placed within the mold and in juxtaposition to the treated portion of the cord, a piece of resin impregnated paper designated 26 of a shape and section bearing a definite relation to the treated portion of the cord and the resultant molded shape. In actual practice I prefer to use what is known as Rogers-board, which has a fibre paper base treated with a heat reactive resin. As a substitute for Rogers-board any fibrous material capable of absorbing heat reactive resin may be used. Material of this kind is available in sheet form and lends itself particularly well to stamping the piece to any desired shape. In the present instance the piece is stamped to T-shape conforming with the shape of the mold cavity. It is also noted that the piece 26 has a central portion 27 extending lengthwise of the cord body beyond the loosened portion thereof and laterally extending portions 28 following what is intended to be the resultant shape of the strain-relief body. Added significance is attached to the thickness of this piece of resin impregnated paper because this is a factor in the final thickness of the molded section which is intended to have a predetermined dimension. It will be apparent that the final molded section will be a composite of the resin impregnated paper and the resin impregnated cord. As shown in Fig. 5, the wire terminals 25 have been bent at 29 in the opposite direction from that shown in Fig. 4 so that they lie in offset parallel relation with the main body of the cord. These terminal ends are confined in the mold in definite relation to the ultimate molded section so that they will project from this section in the desired relation thereto. With the materials arranged in the mold as described, the next step is to close the mold usually by lowering the plunger into the cavity of the mold and develop the required heat and molding pressure upon the resin impregnated paper and the resin treated end of the cord. This pressure, in combination with the heat that is present in the mold, will cause the resin in the Rogers-board and the resin in the fibrous material at the end of the cord to fuse together in a solid homogeneous structure. I have found that molding temperature in the neighborhood of 350° F. and molding pressure of from 3000 to 4000 pounds per square inch is adequate for a molding operation within the space of approximately 60 seconds. After the molding operation the molded article is ejected from the mold and any excess flash which may be kept quite small by the mold design is removed from around the wires 25. It is, of course, understood that in commercial production using this method, multiple cavity molds may be used, thus reducing the unit time and

cost for molding each piece. As a result of the treating of the fibrous material with a synthetic resin and then molding the treated portion to a predetermined shape the resinous material is fused into the most intimate and penetrating relation to the fibres and fills all of the interstices therebetween, thereby producing a solid, coherent and homogeneous body structure reinforced and bonded by the fibrous material. This makes a strong and durable body structure of the desired shape characteristics joined to a flexible fibrous structure. This may be accomplished with or without the addition of a resin impregnated piece such as a Rogersboard section. However, in the embodiment shown in Fig. 9, paper pieces 31 conforming to the shape of the piece 26 but of thinner cross section are applied to opposite sides of the loosened and spread-out terminal portion of the fibrous cord. Here also the body of this treated portion combined with the impregnated paper constitutes the desired cross section of the solid strain-resisting body.

It will be observed that in the attachment plug embodiment the tension forces resulting from pull on the flexible cord are distributed to the strain-resisting molded section through the many fibres and strands whose flexibility characteristics gradually merge into the homogeneous structure of such section. The molded section is at the same time reinforced and tied together by the fibres and strands. It follows that the tension forces exerted by pulling and twisting of the cord are not transmitted to the terminal wires 25 but rather they are resisted by the reaction of the solid body 12 against the abutment faces 11 and the adjacent side wall faces on the plug body according to the direction of the forces. This function is further attained by reason of bending the conductor wires 21 in diverging relation, as shown in Fig. 7, and in confining these wires in the solid molded body which takes all of the pulling and twisting strains from the connections between the wire terminals 25 and their contact elements 16.

From the foregoing it will be apparent that I have provided a new method of making articles of manufacture in which a flexible portion of fibrous material is joined to and becomes a part of a homogeneous molded section. As applied to an appliance cord, the cord proper outside the plug receptacle or casing is flexible and the strain-relief portion located in coaction with the casing is the molded section. This molded section is an assembled fibre structure having excellent wear and strain-resisting properties and providing a durable union with the flexible cord. The molded section also has the further desirable physical properties of low moisture absorption, electrical insulation, and it does not soften or deteriorate from heat. An appliance cord is constructed herein will withstand pulling tensions and twisting or torsion loads far in excess of the Underwriters' requirements above mentioned.

Where my invention is applied to an electric cord intended to be permanently attached to an appliance as distinguished from connection to an attachment plug which has detachable connection with the appliance, an intermediate portion of the cord will be treated in a resin solution, although it is not essential that the fabric sheath be loosened for separating the fibres or strands. Upon this treated portion will be molded a sec-

tion shaped for coaction with the appliance wall or other structure. For example, where the cord passes through a wall of the appliance and it is desired to fasten the cord thereto in a strain-relief connection, the molded section would be annular, circumscribing the cord, and the section would have an annular groove which receives the appliance wall and provides the strain-relief surfaces. With this construction the pulling forces on the cord are resisted by the wall structure and are not transmitted to the terminal connections of the cord.

My invention also contemplates broadly an assembled fibre structure capable of absorbing and retaining a moldable synthetic resin or cellulose derivative and the treating of this structure in part with said resin so that a given portion of the fibrous or woven structure is capable of being reduced to a solid molded section while the remainder retains its soft or flexible physical identity. This may be accomplished either with or without the addition of a resin impregnated piece or section shaped to conform with the general configuration of the resultant molded section. In this broader phase of my invention the assembled fibre structure may be in the form of assembled fibres or strands as in the case of woven flat material as distinguished from an assembled structure such as an electric cord. In such case the molded section may be of any desired shape, pattern or configuration. For example, the assembled fibrous material may be an annular sheet and the molded section may be applied to the peripheral edge portion, making a structure suitable for diaphragms, valves, filters, partitions, and the like.

While I have described several embodiments of my invention, it will be understood that I do not wish to be limited thereto since many modifications may be made, and I therefore contemplate by the appended claim to cover any such modifications a fall within the true spirit and scope of my invention.

I claim:

1. The method of making a strain-relief structure for a fibrous sheath electric cord comprising the steps of stripping the fibrous cover from one end of the cord leaving the terminals bare, loosening the fibrous material at the end of the cord to separate the fibers and strands and provide a laterally spread-out portion, treating the spread-out portion with a heat reactive moldable resin solution to cover the separated fibers and strands and fill the interstices therebetween, stamping from a sheet of heat reactive moldable resin fibrous material a blank having a central portion and laterally extending strain-relief portions, placing said spread-out treated portion and said blank together in a shape corresponding relation in a cavity mold having the ultimate external shape of the strain-relief structure, with the terminals extending from the mold cavity at the opposite strain-relief portions, subjecting the material in the mold to heat and pressure sufficient to fuse the resin materials into a homogeneous mass in which said materials are fused into intimate relation to the fibers and strands, and allowing said material to cool to a solid body in which the sheath cord is molded and in which the spread-out portion is incorporated in the oppositely extending strain-relief portions.

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